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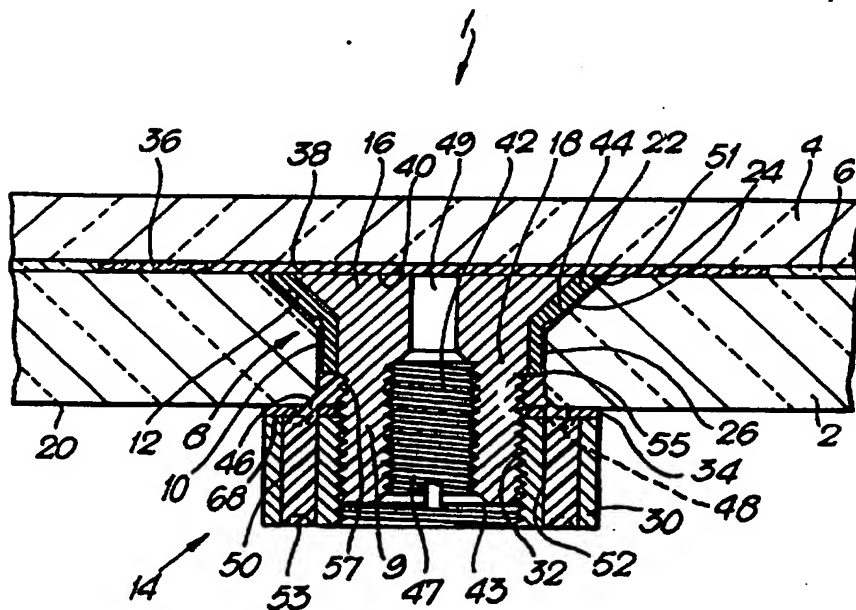
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(54) Title: LAMINATE ASSEMBLIES



(57) Abstract

A laminate assembly (1) has first and second sheets (2, 4) held together by an interlayer (6), and a supporting element (14), which extends through an aperture (8) in the first sheet (2), for suspending the sheets (2, 4) from a structure. The supporting element (14) is bonded to the second sheet (4) by adhesive material in the cavity (38) between the supporting element (14) and the second sheet (4) and bounded by sealing means (36) surrounding the aperture (8). The adhesive material is supplied to the cavity (38) through the supporting element (6) via a central bore (42).

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TITLE

Laminate Assemblies

DESCRIPTION**Technical Field**

The invention relates to laminate assemblies, that is, assemblies having, for example, at least two sheets held together by an interlayer and one or more supporting elements for suspending the sheets from a structure. The invention also relates to a method of making such assemblies which, for instance, with two sheets of glass held together by acrylic resin may be used to glaze the exterior walls of buildings.

Background Art

EP-A-0555991 (Pilkington plc) discloses a cast-in-place laminate assembly for glazing, which is available in the UK from Pilkington Glass Limited under the trade mark PLANAR. The cast-in-place technique of forming an interlayer involves, in this case, holding two sheets of glass spaced apart by means of a peripheral seal, for example a double-sided adhesive tape, and filling the space between the sheets, the cell, through a small gap in the peripheral seal with, for example, a liquid acrylic resin. When cured, the acrylic resin holds the two sheets together.

Supporting elements are provided for suspending the sheets from a structure, such as a building. Each element has a suitable mechanism for attachment to structural members, like stanchions or beams. The obtrusiveness of the elements may be minimised by having them extending through only the inner one of the two sheets, and located spaced from the edge in respective countersunk apertures in that one sheet. This gives the glazing a "flush" external appearance, with no supporting elements protruding through to the outermost glass surface.

As the supporting elements are to extend through only the inner of the sheets and because they are countersunk, they have to be inserted in to the apertures prior to putting the two sheets

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together to form a cell, after which they are clamped to the inner sheet. A sealing mechanism, in the form of a continuous ring of double sided adhesive tape, around each aperture, prevents liquid resin escaping through the apertures, during the filling and curing stages.

A potential problem with the type of assembly described above is that the supporting element only directly supports the inner glass sheet. The outer glass sheet relies for support on the acrylic resin adhering the two sheets together. For many glazing applications, the strength of the acrylic resin more than adequately fulfills mechanical integrity requirements. However, there may be occasions when increased mechanical integrity is required, such as in circumstances where the acrylic resin is subjected to relatively high temperatures, say because the glass of the assembly is solar absorbing and because the level of the incident solar radiation is high, or when high wind loads result in high forces being exerted on the sheets.

It is therefore an aim of the invention to provide a laminate assembly attaining high levels of mechanical integrity and to provide a method of making a safe and durable laminate assembly.

The Invention

The invention provides a laminate assembly comprising at least two sheets held together by an interlayer, a supporting element for suspending the at least two sheets from a structure, the supporting element extending through an aperture in a first of the at least two sheets, and sealing means between the first sheet and a second of the at least two sheets, the sealing means surrounding the aperture, characterised in that the supporting element is bonded to the second sheet by adhesive material in a cavity between the supporting element and the second sheet and bounded by the sealing means.

The bonding of the second sheet to the supporting element means there exists a direct path of support from the second sheet to the structure via the supporting element and the mechanical

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integrity of the assembly is increased above and beyond what would be provided by the interlayer alone. The mechanical integrity is especially increased if a high performance adhesive is used, and the restricted volume cavity means that only a limited quantity of adhesive is required, which can be advantageous because high performance adhesive tends to be expensive in comparison to some interlayer materials. A suitable high performance adhesive material is epoxy resin, examples of which are Scotch Weld DP 105 and Scotch Weld DP 190, both available in the UK from the 3M company.

The supporting element preferably has delivery means for supplying adhesive material to the cavity. The delivery means enables the cavity to be filled with adhesive material after the supporting element has been located in the aperture.

The delivery means further preferably comprises at least one bore passing through the supporting element. The or each bore having a delivery end at a supporting element surface bordering on the cavity and a supply end, opposite the delivery end. Adhesive material is supplied from the supply end to the delivery end where it is expelled into the cavity.

The supporting element may be adapted to receive adhesive material supply apparatus. In particular, the supporting element may have locking means for securing the adhesive material supply apparatus in the bore.

The supporting element may also comprise relief means which provides an escape route from the cavity for air and/or adhesive material. Relief means may be required to prevent air bubbles becoming trapped within the cavity as it is filled, but it is advantageous if the relief means can also serve as an overflow for excess adhesive material within the cavity.

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It is preferred for the relief means to be situated such that the escape of adhesive material is visible. The visible emergence of adhesive material can be used as an indicator that the cavity is full.

The relief means may comprise at least one groove in the surface of the supporting element, the or each groove intersecting the peripheral edge of the supporting element surface bordering on the cavity, thereby placing each groove in communication with the cavity. Each groove may extend to an exhaust chamber which is vented to atmosphere.

The supporting element may further comprise a bearing collar which is adapted to fit between the supporting element and the first sheet, in which case the or each groove is in the surface of the bearing collar.

The supporting element may comprise a central core and a clamping nut which screw together to clamp the supporting element to the first sheet and wherein the relief means comprises at least one canal through the body of the nut. The or each canal connects with the exhaust chamber by virtue of a channel in the clamping surface of the nut, which, when the nut and core are screwed together, coincides with the exhaust chamber.

The supporting element may also comprise a spacer washer between the nut and the first sheet, and wherein the relief means further comprises at least one orifice in the spacer washer. The or each orifice ensures that the route of escape of the adhesive material between the exhaust chamber and the canals is not interrupted by the web of the spacer washer.

The assembly may have a plurality of supporting elements each extending through one of a plurality of supporting apertures in the first sheet, sealing means between the first and second sheets, the sealing means surrounding each aperture, wherein each supporting element is

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bonded to the second sheet by adhesive material in a cavity between that supporting element and the second sheet and bounded by the sealing means.

The invention also provides a method of making a laminate assembly having at least two sheets held together by an interlayer, and a supporting element for suspending the at least two sheets from a structure, the supporting element extending through an aperture in a first of the at least two sheets, characterised in that the adhesive material for bonding the supporting element to a second of the at least two sheets is supplied, with the first and second sheets held together and the or each supporting element extending through the aperture, to a cavity between the second sheet and the supporting element.

The Drawings

Figure 1 is a partial cross-sectional side view of a laminate assembly constructed according to the invention, for glazing;

Figure 2 is a side view of the supporting element core of the laminate assembly shown in Figure 1 and includes a schematic representation of adhesive material supply apparatus;

Figure 3 is an end view taken along the line III-III in Figure 2 but excluding the adhesive material supply apparatus;

Figure 4 is an end view, taken from the cylindrical end, of the supporting element bearing collar of the laminate assembly shown in Figure 1.

Figure 5 is an end view, taken from the clamping surface end, of the supporting element clamping nut of the laminate assembly shown in Figure 1;

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Figure 6 is an end view of the supporting element spacer washer of the laminate assembly shown in Figure 1; and

Figure 7 is a partial cross-sectional side view similar to that of Figure 1 but also shows the means of attachment of the supporting element to a structure.

Best Mode

With reference to Figure 1, a portion of a laminated glazing assembly, indicated generally at 1, has a first sheet of glass 2, constituting an inner sheet, and a second sheet of glass 4, constituting an outer sheet, held together by an acrylic resin interlayer 6. The first and second sheets of glass 2,4 are 10 and 6 mm thick respectively and the acrylic resin interlayer 6 is 1 mm thick. Drilled into the first glass sheet 2 is a circular countersunk aperture 8 which has a cylindrical section 10 and a frusto-conical countersink 12. Only one aperture 8 is shown, but the complete assembly would have one aperture 8 at each corner. Located within the aperture 8 is the core 9 of a correspondingly shaped supporting element 14, having a frusto-conical portion 16 which sits in the counter-sink 12 and a cylindrical portion 18 which extends through the cylindrical section 10 and protrudes out of the aperture 8, beyond the exposed surface 20 of the first glass sheet 2. The core frusto-conical portion 16 sits on a plastics material bearing collar 22 which is adapted to fit between the core 9 and the sheet 2. The bearing collar outer frusto-conical surface 24 bears against the aperture countersink 12. There is also a short cylindrical length 26 to the bearing washer 22 which spaces the core cylindrical portion 18 from the wall of the aperture cylindrical section 10. The supporting element 14 is clamped to the first glass sheet 2 by means of the circular clamping nut 30 which is screwed on to a threaded part 32 of the protruding core cylindrical portion 18. A resilient annular spacer washer 34 (see also Figure 6), around the core cylindrical portion 18, separates the clamping surface 68 of the nut 30 from the first glass sheet 2.

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The acrylic resin interlayer 6 is provided between the glass sheets 2,4 using the cast-in-place technique. This involves holding the glass sheets 2,4 spaced apart with a peripheral seal of double sided translucent adhesive tape (not shown), so as to create a hollow cell into which liquid acrylic resin is poured and subsequently allowed to cure. As the first sheet 2 is apertured, it is necessary to ensure that no acrylic resin escapes through an aperture 8 during the filling or curing cycles. Each aperture 8 is therefore sealed from the remainder of the cell by a surrounding annular ring of translucent double-sided adhesive tape 36, concentrically arranged with the aperture 8, as described in EP-A-0555991. In the assembled laminate 1, when the supporting element 14 has been clamped to the first sheet 2, there exists a cavity 38 between the first sheet 2, or at least the end surface 40 of the core frusto-conical portion 16, and the second sheet 4, and bounded by the ring of adhesive tape 36. A bore 42 passes centrally through the core 9 from a surface 43 at the exposed end of cylindrical portion 18 to the opposite end surface 40. The bore 42 has a supply end 47 nearest the core exposed surface 43 and an opposite, reduced diameter delivery end 49 at the core end surface 40, and is used to supply a liquid epoxy resin adhesive to the cavity 38.

With reference also to Figure 4, in the surface of the plastic bearing collar 22 there are a series of grooves 44, each extending, in a plane parallel to the central axis of the supporting element 14, over the whole length of the collar washer 22, in both the frusto-conical and cylindrical surfaces 24,26 and across the intervening step 56, from an end 51 bordering on the cavity 38, to the opposite end 55, nearest the exposed surface 20 of the first sheet 2. Each groove 44 intersects the peripheral edge at the bearing collar end 51, and with the inner surface of the aperture countersink 12 and the wall of the aperture cylindrical portion 18 thereby forms an enclosed venting passage linking the cavity 38 to a substantially annular exhaust chamber 57 defined by the bearing collar end 55, the wall of the aperture cylindrical section 10, the bearing washer 34 and the core cylindrical portion 18.

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With reference also to Figures 5 and 6, in the web of the spacer washer 34 there are a number of orifices 46 each putting the chamber 57 in communication with a coincidental circular channel 48 in the clamping surface 68 of the nut 30. The channel 48 is connected to atmosphere by a pair of canals 50,52 whose path is from the channel 48, in an axial direction through the body of the nut 30, to an exposed surface 53. An escape route, or relief means, for air that would otherwise be trapped as a result of filling the cavity with epoxy resin and for excess epoxy resin itself is therefore provided from the cavity 38 to atmosphere via the grooves 44, the chamber 57, the holes 46, the channel 48 and the canals 50,52.

With reference also to Figures 2 and 3, the cavity 38 is supplied with epoxy resin adhesive from adhesive supply apparatus schematically represented generally at 54, which has an applicator gun 56 fitted with an applicator nozzle 58 through which epoxy resin is delivered. The nozzle 58 screws into the delivery end 47 of the bore 42 and is thereby locked. Epoxy resin is delivered into the cavity 38 from the nozzle 58 through the bore 42, from the delivery end 47 to the supply end 49 where it is expelled. Air is forced by the incoming epoxy resin out of the cavity 38 to atmosphere successively along the grooves 44, the exhaust chamber 57, the holes 46, the channel 48 and the canals 50,52. Excess epoxy resin also follows the route along the grooves 44, the holes 46, chamber 57, the channel 48 and the canals 50,52 once the cavity 38 is full, (in Figure 1 the presence of epoxy resin is indicated by shading), and eventually emerges out of the open ends of the canals 50,52 at the exposed surface 53 of the nut 30. The visible emergence of epoxy resin can consequently be taken as an indicator that the cavity 38 is full. Once the cavity 38 is recognised as being full, the epoxy resin is left to cure. The cured epoxy resin bonds the surface of the supporting element 14 to the second sheet 4.

When the epoxy resin filling process is complete, the injector nozzle 58 is removed from the bore 42 which is then ready to receive a threaded stub shaft 60 (see Figure 7) for clamping the supporting element 14 between a pair of silicone rubber washers 64,66 to a spring plate 62 attached to a beam in a building (not shown).

CLAIMS

1. A laminate assembly comprising at least two sheets held together by an interlayer, a supporting element for suspending the at least two sheets from a structure, the supporting element extending through an aperture in a first of the at least two sheets, and sealing means between the first sheet and a second of the at least two sheets, the sealing means surrounding the aperture, characterised in that the supporting element is bonded to the second sheet by adhesive material in a cavity between the supporting element and the second sheet and bounded by the sealing means.
2. A laminate assembly according to claim 1 wherein the adhesive material is epoxy resin.
3. A laminate assembly according to claim 1 or claim 2 wherein the supporting element has delivery means for supplying adhesive material to the cavity.
4. A laminate assembly according to claim 3 wherein the delivery means comprises at least one bore passing through the supporting element.
5. A laminate assembly according to claim 4 wherein the or each bore is adapted to receive adhesive material supply apparatus.
6. A laminate assembly according to claim 5 wherein the supporting element has locking means for securing the adhesive material supply apparatus in the or each bore.
7. A laminate assembly according to any preceding claim wherein the supporting element comprises relief means providing an escape route from the cavity for air and/or adhesive material.

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8. A laminate assembly according to claim 7 wherein the relief means is situated such that the escape of adhesive material from the cavity is visible.
9. A laminate assembly according to claim 7 or claim 8 wherein the relief means comprises at least one groove in the surface of the supporting element.
10. A laminate assembly according to claim 9 wherein the or each groove intersects the peripheral edge of the supporting element surface bordering on the cavity.
11. A laminate assembly according to claim 9 or claim 10 wherein the or each groove extends to an exhaust chamber which is vented to atmosphere.
12. A laminate assembly according to any of claims 9 to 11 wherein the supporting element further comprises a bearing collar adapted to fit between the supporting element and the first sheet, and wherein the or each groove is in the surface of the bearing collar.
13. A laminate assembly according to any of claims 7 to 12 wherein the supporting element comprises a central core and a clamping nut which screw together to clamp the supporting element to the first sheet and wherein the relief means further comprises at least one canal through the body of the nut and a channel in the clamping surface of the nut.
14. A laminate assembly according to claim 13 wherein the supporting element comprises a spacer washer between the nut and the first sheet, and wherein the relief means further comprises at least one orifice in the spacer washer.

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15. A laminate assembly according to any preceding claim wherein at least one of the at least two sheets is glass.
16. A laminate assembly according to any preceding claim wherein the interlayer is a cast-in-place interlayer.
17. A laminate according to claim 16 wherein the interlayer is acrylic resin.
18. A laminate assembly according to any preceding claim wherein the sealing means comprises an annulus of double-sided adhesive tape concentrically arranged around the or each aperture.
19. A laminate assembly according to claim 1 comprising a plurality of supporting elements each extending through one of a plurality of apertures in the first sheet, sealing means between the first and second sheets, the sealing means surrounding each aperture, wherein each supporting element is bonded to the second sheet by adhesive material in a cavity between that supporting element and the second sheet and bounded by the sealing means.
20. A method of making a laminate assembly having at least two sheets held together by an interlayer and a supporting element for suspending the at least two sheets from a structure, the supporting element extending through an aperture in a first of the at least two sheets, characterised in that adhesive material for bonding the supporting element to a second of the at least two sheets is supplied, with the first and second sheets held together and the supporting element extending through the aperture, to a cavity between the second sheet and the supporting element.

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21. A method of making a laminate according to claim 20 wherein the interlayer holding the first and second sheets together is cast-in-place.
22. A method according to claim 20 or claim 21 wherein the cavity is bounded by sealing means which is applied so as to surround the aperture, between the first and second sheets.
23. A method according to any of claims 20 to 22 wherein the adhesive material for bonding the second sheet to the supporting element is supplied to the cavity through the supporting element.
24. A method according to claim 23 wherein the adhesive material is supplied through the supporting element from adhesive material supply apparatus.
25. A method according to any of claims 20 to 24 wherein air is forced out of the cavity by the incoming adhesive material.
26. A method according to any of claims 20 to 25 wherein adhesive material is supplied until excess adhesive visibly emerges from the cavity
27. A method according to claim 20 wherein the laminate assembly has a plurality of supporting elements each extending through one of a plurality of apertures in the first sheet, wherein adhesive material for bonding each supporting element to the second sheet is supplied, with the first and second sheets held together and the supporting elements extending through their respective apertures, to a cavity between the second sheet and each supporting element.
28. A laminate assembly made according to any of claims 20 to 27.

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TITLE

Laminate Assemblies

ABSTRACT

A laminate assembly 1 has first and second sheets 2,4 held together by an interlayer 6, and a supporting element 14, which extends through an aperture 8 in the first sheet 2, for suspending the sheets 2,4 from a structure. The supporting element 14 is bonded to the second sheet 4 by adhesive material in the cavity 38 between the supporting element 14 and the second sheet 4 and bonded by sealing means 36 surrounding the aperture 8. The adhesive material is supplied to the cavity 38 through the supporting element 6 via a central bore 42.

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Fig.1.

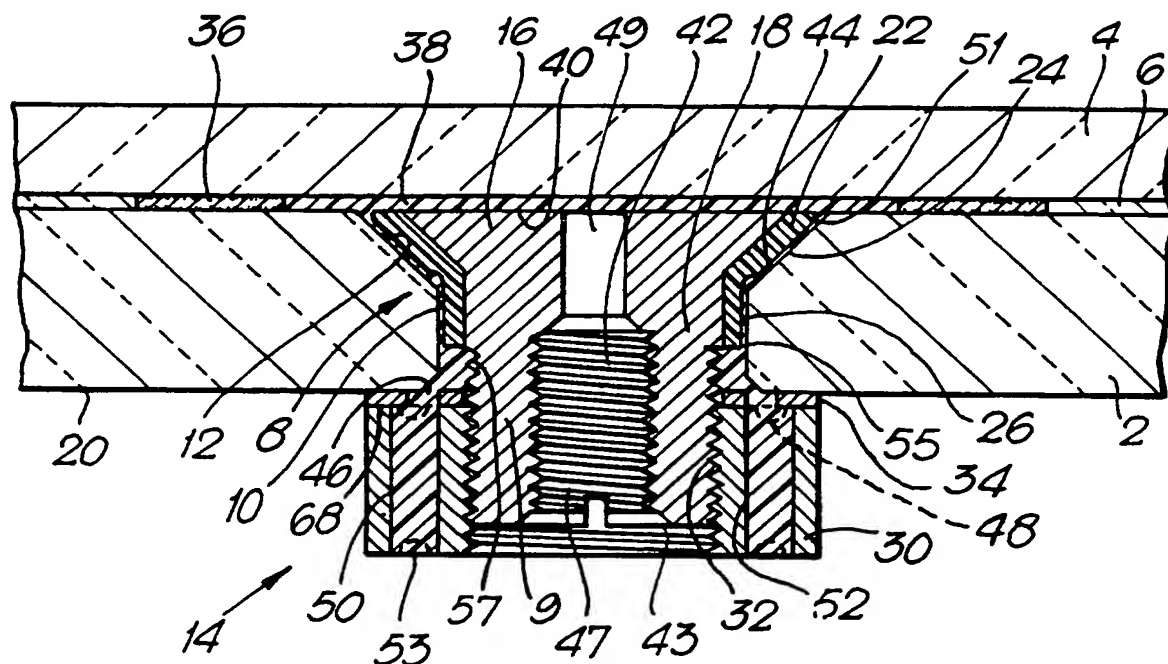


Fig.2.

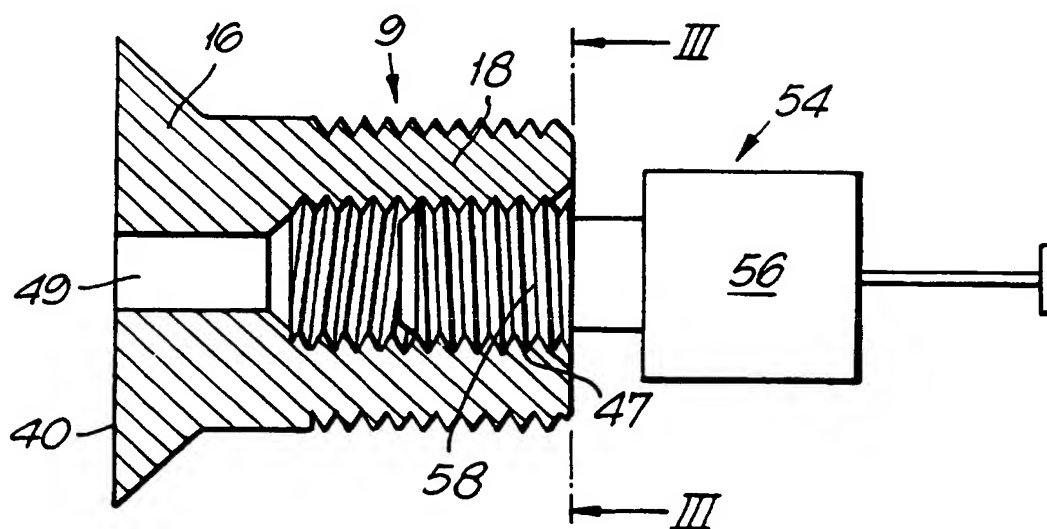


Fig.3.

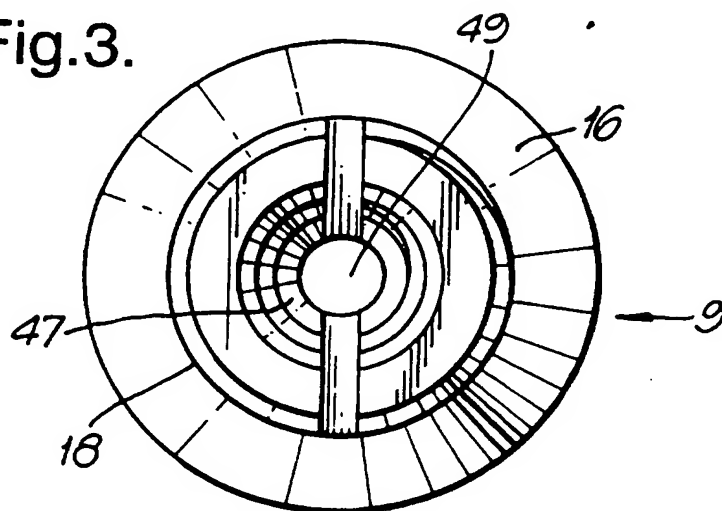


Fig.4.

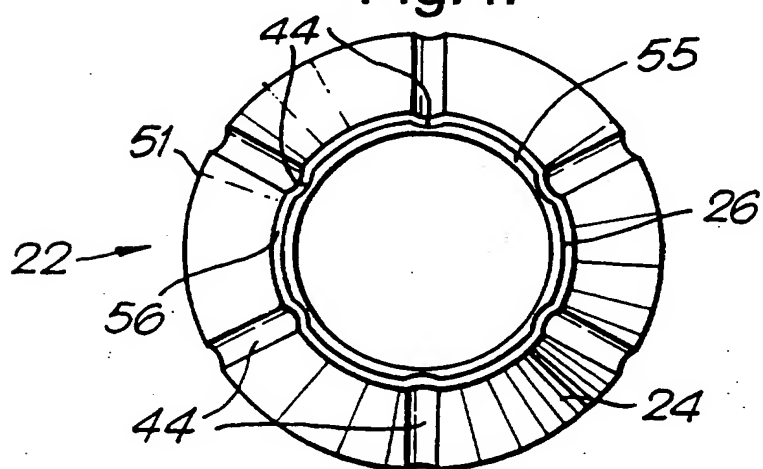


Fig.5.

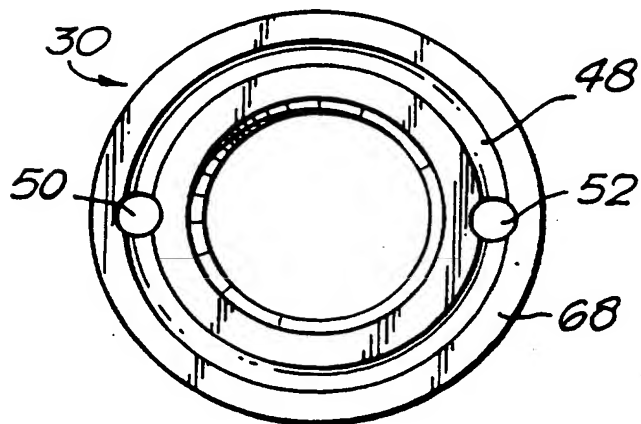


Fig.6.

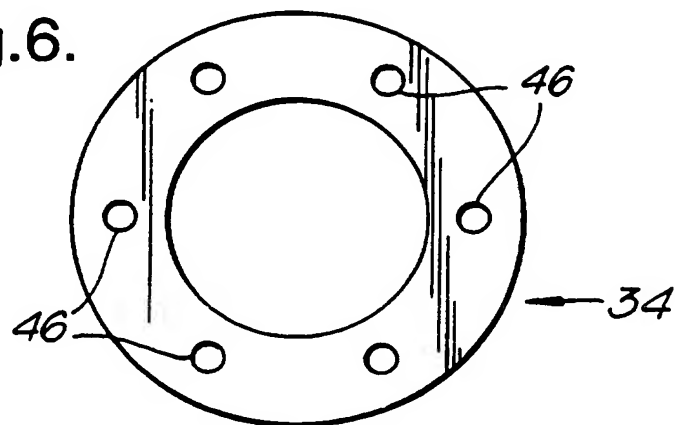
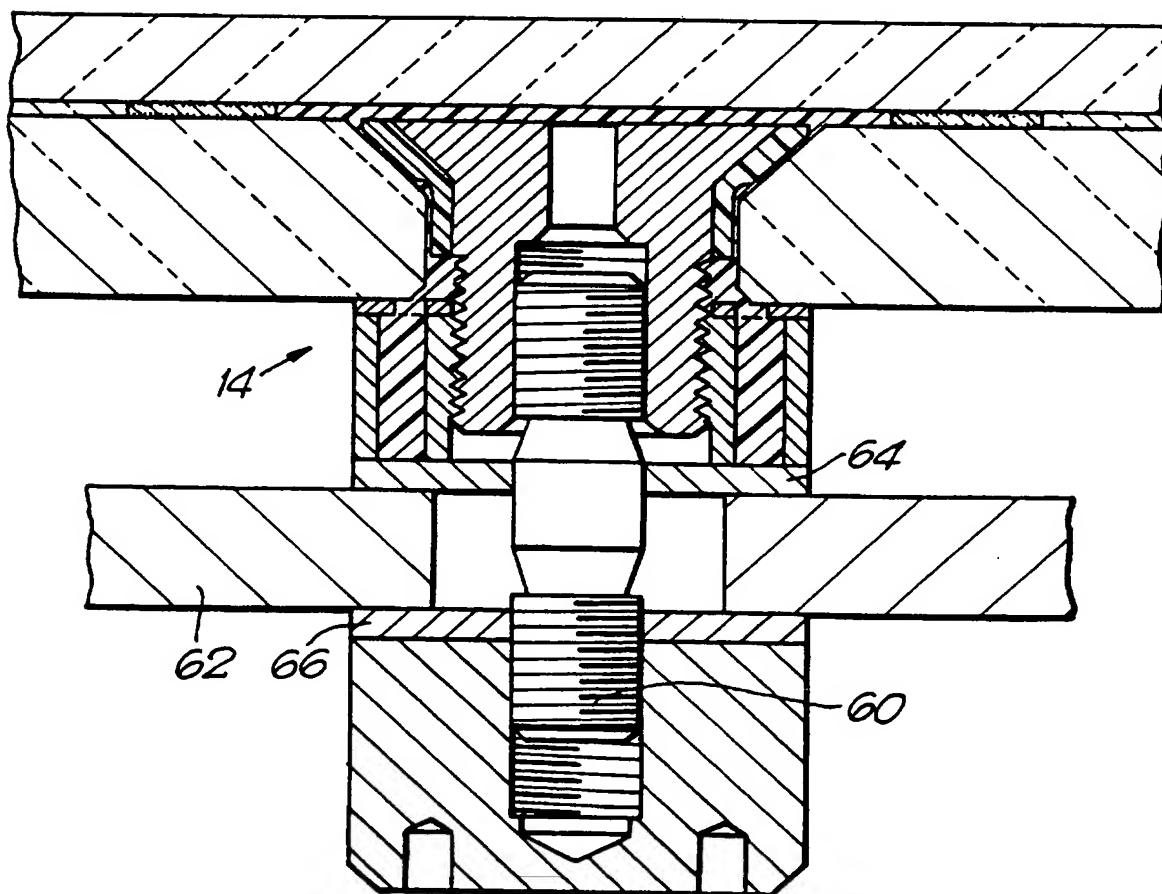


Fig.7.



INTERNATIONAL SEARCH REPORT

Internat Application No
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IPC 6 E06B3/54 E04B2/88

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP,A,0 340 089 (SAINT-GOBAIN VITRAGE) 2 November 1989 see column 3, line 25 - column 4, line 58; figures -----	1,15,19, 20,27

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